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THE VETERINARY JOURNAL

A MONTHLY REVIEW OF VETERINARY SCIENCE

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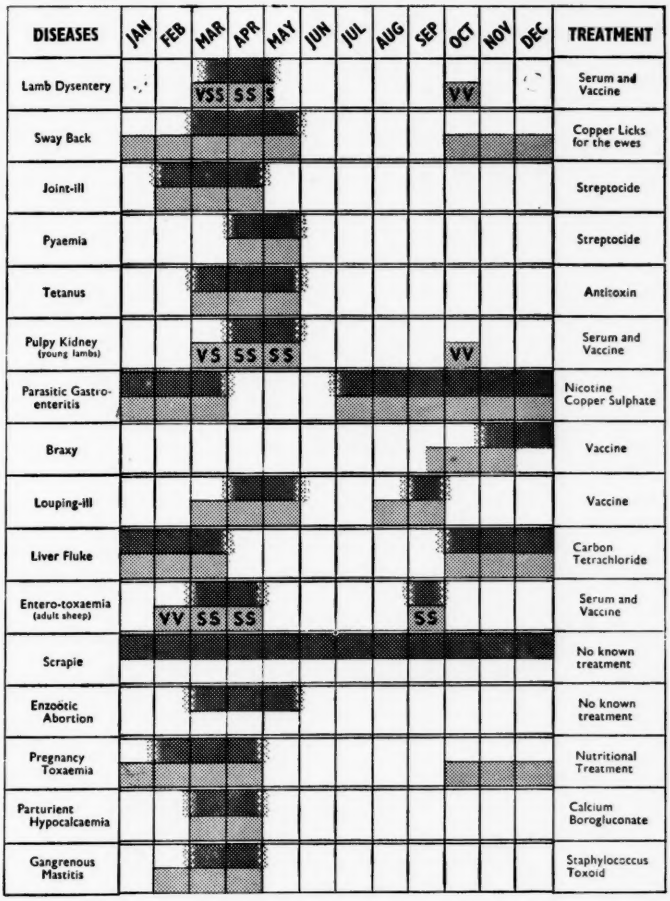

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THE VETERINARY JOURNAL

EDITORS: T. DALLING, *M.A., M.R.C.V.S.* J. McCUNN, *M.R.C.V.S., L.R.C.P.*

Vol. 103 December, 1947 No. 12

EDITORIAL

THE PART OF THE VETERINARY PROFESSION IN FOOD PRODUCTION

THE present position of acute shortage of food for use in this country calls for great efforts on the part of all concerned with agriculture. Targets have been set for the next few years and they include livestock as well as the various agricultural crops. It is aimed to produce more meat, milk and eggs for home consumption. This can be done only by increasing our flocks and herds, by breeding more productive and better quality livestock and poultry, and by ensuring that the health of the stock is such that maximum yields can be obtained and wastage reduced to a minimum. It is quite patent that more can be done to give effect to these projects, and the part to be played by the veterinary profession will go far to obtain the desired results. Much has already been accomplished by the profession, but we have still to do much more. The veterinary profession has the basic scientific training and knowledge with which to assist the farmer: it remains for him to use that training and knowledge to the best advantage.

During and since the last war there has been a definite change-over in the type of work carried out by veterinary surgeons. The treatment of the individual animal, though still practised to a considerable extent, has given place to the treatment of the herd, with the result that health and disease control has been brought home to the stock-owner. He now realises that it is not enough to call the veterinary surgeon to attend an animal when some accident or illness occurs, but that a much better policy is to seek advice on how to preserve the health of the herd and flock and to maintain it at a high level of production; he has become anxious to increase the production rate and relies on the veterinary profession to assist him in that object. The seed is sown and the wise farmers are reaping a good harvest. This type of work must be still further encouraged and applied. Control of the major scourges which affect livestock leads not only to freedom from such afflictions in the herd but minimises some of the simpler ailments which, in their turn, lower the efficiency of individual animals and so affect the general yields. It is generally accepted, for example, that the elimination of bovine tuberculosis from a dairy herd results in a lower incidence of many other simpler ailments and that the absence of brucellosis is often followed by a considerable lowering of the incidence of infertility.

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The diseases of dairy cattle of major importance to-day, omitting the occasional visits of foot-and-mouth disease, are tuberculosis, mastitis, brucellosis and diseases giving rise to infertility. The results of research work, when applied in the herd, enable veterinary surgeons to control them. We have made great strides in our knowledge of the causes and methods of control of these conditions, and the veterinary profession is now using the available information in their daily work. Research workers study the causes of the disease; they evolve methods of control in their laboratories; they carry their techniques into the field and show how they can be applied; then the methods are adopted by the veterinary surgeons in their day-to-day duties. In the evolution of control measures all branches of the profession have an important part to play, and it is only after all have participated in the investigations that the best and most practical and economic methods of control are devised. While we as a profession must take a large share in all this investigation work, we must also have the assistance of those who are well informed in other branches of science. The effort must be such that all who can make a contribution are used to the full extent.

Maximum productivity in livestock is also concerned with other aspects than the control of disease. Breeding for production is now better understood and is being practised. The introduction of artificial insemination has carried with it opportunities throughout the country to improve breeding with a view to increased production. The various techniques in this operation have been studied and a good working method is being used: further information is necessary on the economy of artificial insemination in order to obtain the maximum service from the good proven bulls. Veterinary surgeons are largely concerned in this work and their advice to the farming community on it is of first-rate importance. The feeding, housing and general husbandry of herds and flocks means a lot in production results, and the veterinary surgeon has an essential part to play in giving advice on them. It is his duty to assist farmers with all their problems concerning livestock, and it is to him that the farming community looks for assistance in its problems.

We have certainly a big contribution to make and we must see to it that we do our bit, giving of our best. By so doing we will assist in no small measure in the drive to increase the food supply of the country which is so much needed during the next few years.

Greetings

THE Editors and Publishers are happy to take this opportunity of wishing their readers the Compliments of the Season, and express their hopes that 1948 will see the country, and the profession, well on the march to prosperity, and that this will be the last "Austerity Christmas."

GENERAL ARTICLES

TOXIC HEART DEGENERATION, OR "ROUND HEART DISEASE," OF POULTRY

By J. D. BLAXLAND and L. M. MARKSON

Ministry of Agriculture, Veterinary Laboratory, Weybridge

Introduction

FISCHEL (1946) reported that from 1941 he had encountered 38 outbreaks of a fatal disease in poultry in New Zealand, which he named "Enzootic Fatal Syncope (Toxic Heart Degeneration)." Luke (1946) recorded 36 outbreaks of a condition in poultry flocks in Northern Ireland, which he called "Round Heart Disease." At the time of publication, neither author was aware of the other's report, but there is little doubt that both workers were describing the same condition. Wilson (1947), having seen Luke's article, reported the occurrence of a similar condition in two flocks in Scotland.

Prior to December, 1946, this condition had not been seen at Weybridge amongst the numerous specimens received daily for post-mortem diagnosis, but about the middle of December excessive mortality began to occur among the fowls entered in a large commercial laying trial in the North of England, and post-mortem examination revealed lesions almost identical to those described by Fischel, and later by Luke. During the first six months of the 1946-47 trial, the mortality rate showed a steep rise as compared with the previous year, and of this mortality 69 out of a total of 126 fowls showed evidence of heart disease. At the end of the seventh month the percentage mortality was 10.7, as compared with 10.5 for the whole of the 1945-46 trial. From the middle of March the mortality rate returned to normal and no unusual conditions were encountered.

In addition to this major outbreak, four others of minor importance occurred during January and February, 1947, with only small numbers involved.

Description of the Trial

The trial is an annual commercial egg-laying test, pullets arriving each year in September and remaining there during their first year's production. Pens of four, six, twelve and also single fowls are entered from flocks from all parts of England and Wales, and in the 1946-47 trial there were altogether 145 competitors, involving a total of 1,178 birds. Housing conditions and management were the same as in previous years; each house contained two pens of birds separated from one another by a wire partition, each pen having a separate grass run. The trials have been conducted on the same ground and with the same equipment for the past twenty years.

The Course of the Disease

From the beginning of October until early in December, 1946, no unusual mortality occurred. Round Heart Disease was first recognised on December 11 and three further cases were diagnosed before the end of the month. The peak of the mortality occurred during January, February and March; during April only three further fatalities from this disease were encountered (*see the table on page* 402).

In only five pens did more than two deaths occur, in eleven pens two birds died and in fourteen pens there was only a single death. In the single bird section there were eight deaths. Of the five pens in which more than two deaths occurred from the heart disease, three each containing twelve R.I.Rs. were in the same section of the test and in two of them five birds died, in the other four. In one pen of R.I.Rs. in another section, four birds out of a total of seven died, an additional point of interest being that this pen was entered by the same owner as the pen of twelve R.I.Rs. in which the four deaths occurred. The fifth pen in which high mortality took place was one of twelve White Leghorns, seven of which died.

These details demonstrate the purely haphazard occurrence of the disease and are of interest in assessing the possibility of the presence of an infectious agent. The mortality due to the unknown heart disease as compared with the total mortality for the months under review is shown in the table:—

Year	Total mortality	Heart disease	Other conditions
1946—			
October ...	2	0	2
November ...	9	0	9
December ...	13	4	9
1947—			
January ...	30	24	6
February ...	33	23	10
March ...	22	15	7
April ...	17	3	14
Total ...	126	69	57

Symptoms

Death in every instance was sudden, occurring sometimes immediately after feeding, the attendant's attention being directed to the house by the noise of the bird's wings flapping immediately before it died. In a very small number of instances, the dead fowl had been noticed to be lethargic for a few days, the comb becoming rather blue and shrivelled at the tips. The majority, however, seemed in excellent condition, with large red combs and wattles, although with one or two exceptions the records showed that they had not laid for many days, frequently not for several weeks.

The symptoms described by the owners in the four other outbreaks were almost identical to those described above; the deaths of individual fowls occurred suddenly, and in three of the four cases the owner mentioned specifically that the birds appeared to drop dead when running towards the attendant at feeding time.

Macroscopical Examination

The general post-mortem appearance of fowls which had died of this condition was that of acute cardiac failure. Approximately 69 per cent. of the

PLATE 1.—Four "round" hearts—the central heart is normal.

PLATE 2.—Cloudy swelling, loss of striation, and fragmentation of the myocardial fibres. Hæmatoxylin and eosin. X 1650.

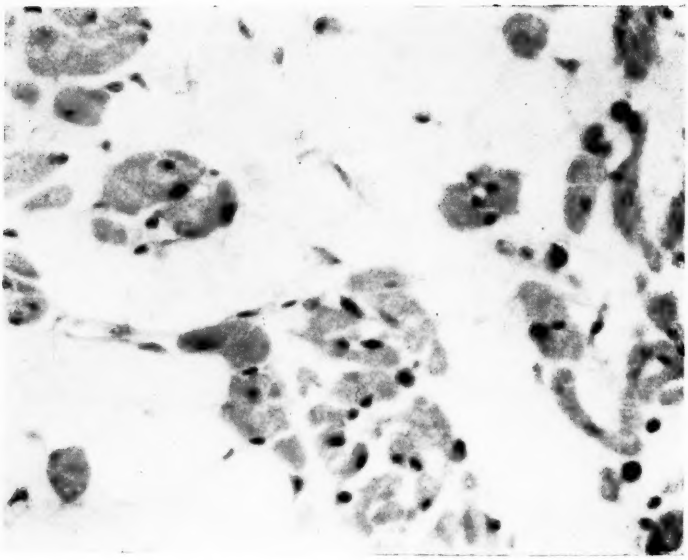

PLATE 3.—Disruption of the myocardial structure resulting from fatty infiltration. Hæmatoxylin and eosin. X 1650.

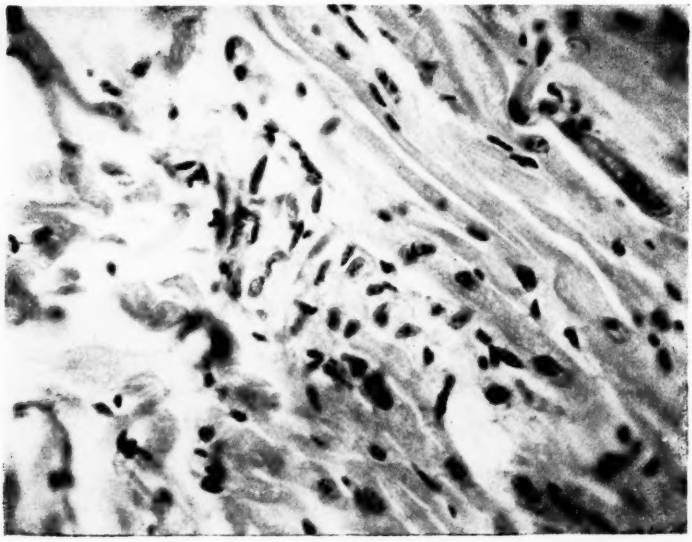

PLATE 4.—Fibroblasts healing a small breach in the myocardium. Hæmatoxylin and eosin. X 1320.

carcasses examined from the laying trial were of birds in good bodily condition, and in most cases, except for the heart lesions, there were no other obvious pathological changes. The liver and kidneys showed acute, passive hyperæmia; the lungs were often œdematous; the spleen was usually normal in size and colour. In a few of the carcasses, there was a sero-gelatinous exudate surrounding the heart and covering the surface of the liver, but this was not a very common finding. In 32 per cent. of the affected birds there was evidence of digestive disturbance shown by varying degrees of impaction of the crop and gizzard. A further point of possible significance was that in 78 per cent. of the carcasses the ovary was inactive.

The most striking abnormality occurred in the hearts which were generally enlarged both in volume and in weight. A normal adult fowl's heart weighs about 12 grammes, but typical "round" hearts usually weighed from 13 to 16 grammes and in three instances as much as 21 to 23 grammes. In some of the hearts the increase in size was due to dilatation of the organ, but in the majority the myocardium was itself thickened. The heart muscle appeared degenerated, pale and rather fatty or, quoting Fischel, "had a parboiled appearance." In most instances there was a well-marked deposit of fat over the atria, the coronary vessels being usually prominent and engorged with blood. The apex in most cases was markedly rounded and there was often a small indentation at the point. In less advanced cases there appeared to be a more patchy degeneration of the myocardium chiefly confined to the left ventricle, the effect being to destroy the symmetry of the organ, while in some hearts the degenerated area appeared to protrude from the normal line of the organ.

Microscopical Examination

Portions of each specimen were fixed in 10 per cent. formol saline, embedded in paraffin wax, sectioned and stained by Ehrlich's hæmatoxylin and eosin; other sections were stained by Weigert's iron hæmatoxylin and van Gieson's stain, others by Weigert's iron hæmatoxylin alone, while a few pieces after formol fixation were sectioned frozen and stained by Scharlach R for fat.

A total of fifteen hearts was examined, the changes in each being essentially the same, varying mainly in degree. Acute degenerative changes were observed ranging from cloudy swelling through fatty degeneration and in some cases infiltration, to necrosis. These changes were accompanied by vacuolation of the myoplasm and loss of its transverse striations and normal affinity for eosin, and by longitudinal fibrillation of the myocardial fibres, fragmentation and nuclear degeneration.

In one heart there was some leukocytic infiltration of the myocardium; in another a small lymphomatous focus was seen. Myocardial œdema was a common feature. Fibrogenesis was seen in only two the hearts examined; in one, necrosis was fairly generalised and the arrangement of proliferating fibroblasts quite haphazard; while in the other, fibroblasts were arranged regularly and transversely across gaps in the fragmented muscle bundles.

Sections of lungs, liver, spleen and kidneys were examined from three carcasses. These tissues all showed acute, passive hyperæmia. In the liver

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sections there were also early degenerative changes in the hepatic cells, which changes, however, were uniformly distributed and consisted mainly of cloudy swelling and very slight fatty changes. The kidney sections also showed generalised degeneration of the epithelial elements of the tubules. It must be remembered that the histological material was not fresh when received, so the question of post-mortem autolysis must be considered.

The microscopical changes appeared to be those of an acute diffuse myocarditis, the condition having been terminated by sudden fatal heart failure. The cardiac lesions observed in most of the specimens examined would not have taken, in our opinion, more than a few days to develop, and in the two instances where fibrogenesis was seen, perhaps two to three weeks. The increase in volume of most of the hearts was due to dilatation, the slight increase in weight over the average could be accounted for by inter- and intra-fibrillar œdema. But three hearts weighed 21, 23 and 23 grammes respectively and showed a much thickened myocardium; as the microscopical changes were acute, this was considered to be clear evidence of gross hypertrophy succeeded by myocardial degeneration and failure of compensation.

Bacteriological Examination and Transmission Experiments

Extensive bacteriological examination was carried out in all the earlier cases but no micro-organisms could be incriminated. Transmission experiments using bone marrow, liver and spleen emulsions were completely negative in adult fowls and baby chicks. An unfiltered saline emulsion of ground-up heart tissue from typical cases of the disease was inoculated into fertile eggs after testing the inoculum for bacterial sterility; the embryoes were apparently unaffected and the eggs hatched normally.

Discussion

It was felt that the negative results of the transmission experiments and bacteriological examinations warranted the conclusion that the disease was not due to a transmissible agent; furthermore, the sporadic occurrence of the individual cases in the laying trial seemed to eliminate the possibility of its being infectious. Having failed to establish the presence of an infection, attention was directed to the possibility of a dietetic cause. Once again investigations were entirely negative. All birds in the trial received the same mash, comprising 50 per cent. National Layers mash together with sharps, bran, Sussex ground oats, ground nut meal, fish meal, alfalfa and, in addition, a scratch feed of mixed grain; the water was drawn from the same well on the test ground as in previous years. The history and macroscopical examination suggested that the disease was of a chronic nature. The inactive ovaries in so many cases and the evidence of a dietetic disorder supported this conclusion, but the microscopical examination contradicted it. The microscopical changes were mostly of an acute type, and in only two instances was there evidence to suggest that the condition might have taken more than one or two weeks to develop. However, the myocardial hypertrophy already described suggested that the cardiac condition was not primary but might have been a sequel of a more remote disorder.

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Both Luke and Fischel obtained similarly negative results in their investigations along these lines, but the latter expressed the opinion that the condition may be due to a shortage of green food because in New Zealand the disease occurred regularly in the late winter and early spring. The outbreak reported in this paper was confined to the months of December to April, and the mortality was actually highest during the very severe weather of January to March, 1947. During most of February the birds were confined to their houses owing to the deep snow. Wilson (1947) also refers to a well-marked seasonal incidence in the Scottish cases, all of them occurring from February to April, but he is of the opinion that the heart lesion "represents an anatomical abnormality persisting from the time of hatching." The Northern Ireland cases reported by Luke, on the other hand, occurred from June to November, a season during which green food would surely be abundant.

Wilson's report is interesting in that the outbreaks were all confined to two flocks, and presumably his opinion—that the disease is due to an anatomical abnormality—is based on the theory that there is some genetical factor involved. Neither Fischel nor Luke mentions this possibility, and in the outbreak reported here, it would seem to be a very unlikely cause, in that 32 of the 145 different owners with birds entered in the trial, actually suffered losses. On the other hand, as pointed out earlier, it may be significant that 25 of the 69 cases occurred in the pens of fowls entered by only four owners.

Luke and Wilson do not report having carried out any microscopical examination, but Fischel describes cloudy swelling and degeneration of the myocardial fibres, which appear to be similar to the changes already described in this paper. He suggested that the condition was due to a "toxic cause with an elective action on the heart muscle." As stated above, however, careful and thorough investigation in the outbreak here reported failed to reveal any concrete factor to which the losses could be attributed.

Summary

An outbreak of Toxic Heart Degeneration or "Round Heart Disease" in poultry is described in detail. Sixty-nine cases were diagnosed out of a total mortality of 126 which occurred during the first seven months among the fowls entered at a commercial laying test in the North of England. Four other outbreaks, which were encountered during January and February, 1947, are also mentioned.

The possible ætiology and pathogenesis of the disease are discussed, reference being made to three other reports of what appears to be the same condition.

Acknowledgments

The authors wish to acknowledge help received from the staff of the Pathological Section in the preparation of material for microscopical study, and from Dr. R. F. Gordon, under whose direction the work of the Poultry Diagnosis Department is carried on.

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CRYSTAL VIOLET SWINE FEVER VACCINE

By T. M. DOYLE and E. C WRIGHT
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DURING the years that have passed since the first report by McBryde and Cole (1936) on Dorset's crystal violet vaccine, much work has been carried out on it in different parts of the world under both laboratory and field conditions. It is clear from published results that the vaccine, when properly prepared, does not transmit the disease and that it confers a high degree of protection against both natural and artificial infection. That it contains no active virus is a point of cardinal importance, as it eliminates the risk of disseminating infection which is so serious an objection to methods of immunisation that depend for their action on the presence of live virus.

Preparation of the Vaccine

It is essential, when bleeding the infected animals and in preparing vaccine, that the blood should not become contaminated as this reduces potency and gross contamination renders it useless. The maintenance of stock virus is another point that requires consideration. In our experience, freeze-drying of swine fever virus, followed by storage *in vacuo* at —20° C., has not been entirely satisfactory; it would appear to cause a slow but progressive deterioration in antigenicity. The storage of virus as defibrinated blood at —70° C. has given good results. Comparative tests have been made with three samples of crystal violet obtained from different manufacturers, and no appreciable difference in their suitability for vaccine preparation was observed. The most important factor in the production of potent vaccine would appear to be the use of a good antigenic strain of virus. This point is dealt with later in this article.

In preparing vaccine we have, on the recommendation of the Bureau of Animal Industry, Washington, replaced dibasic sodium phosphate with ethylene glycol. It is claimed that by the use of ethylene glycol the degree of contamination can be considerably reduced. We have no evidence on this point, as no difficulty has been encountered here in preparing repeated batches of sterile vaccine by the practice of normal laboratory technique. The use of ethylene glycol has, however, eliminated the heavy deposit that occurs with dibasic sodium phosphate on standing, and in general it produces a smoother and more satisfactory product. The dye solution is made by dissolving one gram of crystal violet in 400 c.c. of ethylene glycol. To prepare the vaccine, 200 c.c. of 1 : 400 crystal violet-ethylene glycol solution are added to 800 c.c. of defibrinated blood and the mixture incubated for 14 days at 37° C.

Effect of Storage on Vaccine

This is a point of practical importance, as in the use of vaccine under field conditions it would not always be possible to store it under the optimum conditions

available at a laboratory. Cole and McBryde (1941) have shown that when vaccine was kept for four years in the cold or for eight weeks at 37° C., there was no appreciable loss in antigenicity. We have carried out the following tests. Two pigs (834 and 844) were inoculated with virus, bled out on the sixth day and vaccine prepared. Immediately after preparation, the vaccine was tested in varying doses on three pigs. The remaining portion was divided into two parts: one part was kept for 38 days in the dark at room temperature (55° F.), and the other part was kept in the cold room (34° F.) (see Table).

Vaccine tested	Number of Pig	Dose of Vaccine	Test dose of virus on the 21st day after vaccination	Remarks
Immediately after preparation	886	10 c.c.	1 c.c.	Remained normal
	882	5 c.c.	„	„ „
	894	2 c.c.	„	Died SF 7th day
	898	Control	„	Died 6th day
After 38 days at room temperature	891	10 c.c.	„	Remained normal
	892	5 c.c.	„	„ „
	879	2 c.c.	„	„ „
	945	Control	„	Died 13th day

There was no change in the potency of the vaccine held for 38 days in the dark at room temperature. It was submitted to a similar test after 248 days and there was still no change in its protective value within the range of doses used. A further test was carried out after 740 days and it was found that the vaccine had almost completely lost its antigenicity. Similar tests were made at yearly intervals on vaccine kept in cold storage (34° F.), and there was no appreciable loss in antigenicity after 3½ years.

Effect of Immune Serum on Vaccinal Immunity

It is probable that in dealing with some outbreaks of swine fever in the field, immune serum will have already been injected and the question will arise as to the interval that should elapse before it would be safe to follow up with vaccine.

McBryde and Cole (1936) tested the effect on immunity of:

(1) Simultaneous inoculation of vaccine and serum.

(2) Vaccine followed a week later by serum.

(3) Vaccine followed a week later by serum and virus.

The results indicated that when pigs were given vaccine and serum simultaneously, or serum within seven days of vaccination, the antigenic power of the vaccine was inhibited by the serum.

We have carried out the following experiments in an attempt to obtain further information on these points. Eleven pigs of a uniform size and an average weight of 60 lb. were injected with an American immune serum in doses appropriate for their weight. Vaccine (10 c.c.) was given to one pig simultaneously with the

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serum, and to the remainder of the group at varying intervals afterwards. This was followed up with a test dose of virus (see Table).

Pig Number	Vaccine after Serum. Days	Virus (1 c.c.) after Vaccine. Days	Results
1359	0	50	Remained normal
1361	1	49	" "
1362	3	47	" "
1367	5	45	" "
1364	7	43	" "
1363	9	41	" "
1368	10	40	" "
1366	15	35	" "
1369	18	32	" "
1371	22	28	" "
1373	28	22	" "
1568	Virus control	—	Died 10th day

It would appear from these results that the simultaneous injection of vaccine and serum or the injection of vaccine at varying intervals after serum does not always inhibit the antigenic action of the vaccine. In view of the possibility of some residual protection from the serum, a second experiment was carried out. Serum was given five days before vaccine, serum and vaccine given simultaneously, and serum given five days after vaccine. The test virus was given three months after the serum (see Table).

Number of Pigs	Method of Treatment	Results
1	Vaccine alone.	Remained normal.
1	Serum alone.	Died of Swine Fever.
2	Vaccine and serum simultaneously.	One died, other reacted severely and recovered.
2	Vaccine five days before serum.	Both remained normal.
2	Serum five days before vaccine.	Both remained normal.
3	Virus controls.	Died 7th, 8th and 17th respectively.

The results of this experiment suggest that immune serum may be given either five days before or five days after vaccine without inhibiting the antigenic action of the vaccine. In this instance, serum given simultaneously with vaccine inhibited the antigenic action of the vaccine.

An Attempt to Reactivate the Virus

These experiments were carried out in an attempt to reactivate the virus contained in the vaccine.

Pig 1219, 95 lb. weight, was given 180 c.c. of vaccine: 100 c.c. intravenously, 60 c.c. subcutaneously, and 20 c.c. intramuscularly. During the following 14 days, the temperature fluctuated between 101° and 105° F., although the pig appeared normal and fed well. A susceptible pig (No. 1184) placed in contact with the vaccinated pig for 40 days remained normal. It was then tested with virus and died on the ninth day.

Test II.—Pig 2117, 100 lb. weight, was given 100 c.c. of vaccine: 50 c.c. intravenously, 30 c.c. subcutaneously, and 20 c.c. intramuscularly. The temperature showed a small rise (1°-2° F.) during the following 48 hours and then

returned to normal. Blood was drawn six times (at 24, 48, 96, 120, 168 and 192 hours after vaccination) into sodium citrate and the equivalent of 1 c.c. whole blood inoculated on each occasion into a susceptible pig. These pigs remained normal. In addition, a susceptible pig (No. 2191) was placed in contact with No. 2117. A month later, the immunity of the six pigs injected with blood and the in-contact control was tested with virus and all died.

Vaccination of Unweaned Pigs

This experiment was to ascertain if unweaned pigs the progeny of a swine fever susceptible sow could be protected with vaccine. It is known that young pigs can be readily immunised from about two weeks after weaning.

A sow (No. 899) and her litter of 12 pigs, aged 24 days, were treated with vaccine. The sow and three pigs were each given 10 c.c. of vaccine, five pigs received 5 c.c. each, and four were left untreated and later used as virus controls. Twenty-two days after vaccination, the sow and litter were inoculated with virus. The vaccinated animals remained normal and the four controls died. The results show that crystal violet vaccine can be safely used on unweaned pigs and that it confers a solid immunity on them. Some time later a second litter, comprising eight pigs, from the same sow (No. 899), now immune following vaccine and virus inoculations, was treated when one month old with varying doses of vaccine. The pigs were divided into two groups; one group was tested for immunity by continuous contact with an infected pig, and the second group by the inoculation of virus. A third group, consisting of five pigs the progeny of a swine fever-susceptible sow, was included in the experiment as a control to the efficacy of the vaccine; one pig (No. 5) from this group was left unvaccinated and later given virus to verify the susceptibility of the litter (see Table).

	Number of Pig	Origin of Pigs	Dose of Vaccine c.c.	Tested after Vaccination Days	Immunity tested by:	Result
Group I	1	Virus Immune Sow (No. 899)	2	150	Contact infection	Died 20th day
	2		3	"	" "	" 24th "
	3		4	"	" "	" 22nd "
	4		5	"	" "	" 30th "
	5		Virus Pig	—	——	" 12th "
	6		Untreated control	—	Contact infection	" 15th "
Group II	1	Virus Immune Sow (No. 899)	2	150	Inoculation of virus	Severe reaction
	2		3	"	"	Died 24th day
	3		4	"	"	" 31st "
	4		5	"	"	Severe reaction
	5		Virus control	—	"	Died 16th day
Group III	1	Unvaccinated Sow	2	150	Inoculation of virus	Slight reaction
	2		3	"	"	Remained normal
	3		4	"	"	" "
	4		5	"	"	" "
	5		Control	To verify susceptibility of group	"	Died 11th day

These results show that crystal violet vaccine does not confer a durable immunity on unweaned pigs, the progeny of a virus-immunised sow.

Vaccination of Unweaned Pigs the Progeny of a Vaccinated Sow

A comparative vaccination test was carried out between the third litter from the virus-immunised sow (899) and a litter from a sow (907) that had been treated with crystal violet vaccine. Five pigs from one litter and six from the other were each inoculated when 30 days of age with 5 c.c. of vaccine. One pig from each litter was left untreated and later given virus to verify the susceptibility of the litter. The immunity of pigs from each litter was tested at varying intervals after vaccination by the inoculation of virus; virus control pigs were included at each inoculation and all died. (See Table.)

Crystal Violet Vaccinated Sow (907)			Virus-immunised Sow (899)		
Number of pig	Tested after vaccination Days	Result	Number of pig	Tested after vaccination Days	Result
1844	27	Remained normal	1835	27	Remained normal
1843	70	" "	1839	27	" "
1848	126	" "	1836	70	Died 12 days
1845	175	" "	1838	126	Died 20 days
1846	180	" "	1837	175	Died 13 days
			1840	180	Died 15 days
1841 (Control)	—	Died 13 days	1833 (Control)	—	Died 14 days

It would appear from these results that crystal violet vaccine confers a durable immunity on unweaned pigs, the progeny of a crystal violet vaccinated sow. Whereas only a short period of protection is conferred on unweaned pigs the progeny of a virus-immunised sow.

Vaccination of Pigs infected with S. choleræ suis

The eight pigs used in this experiment were obtained through the courtesy of Dr. G. Slavin who had subjected them for fifty-eight days to ground infection with *S. choleræ suis*. Several of the pigs had persistent diarrhœa as the result of infection. At the time of vaccination none showed either "H" or "O" agglutinins for *S. choleræ suis*, but a month earlier four had shown "H" titres varying from 1 : 5 to 1 : 40, and one pig had an "H" titre of 1 : 640.

Six pigs were treated with vaccine (10 c.c.) and two were left untreated and later used as virus controls. Twenty-five days after vaccination each pig was given 1 c.c. of virus subcutaneously. The vaccinated pigs remained normal and the two controls died in ten and thirteen days, respectively. It would appear that pigs infected with *S. choleræ suis* can, provided they are in good condition, be immunised with crystal violet vaccine. In view, however, of the considerable influence exercised by diet and hygiene on predisposition to *S. choleræ suis* infection, the results of this type of experiment carried out on pigs in well-constructed buildings, and receiving a balanced diet, is little criterion of what may happen under the varying conditions of hygiene and diet that occur on farms. The final answer of the value of vaccine for pigs heavily infected with *S. choleræ suis* must therefore await results obtained from the field. The evidence available at present suggests that vaccination will not reactivate latent secondary bacterial infections.

To Ascertain if Vaccinated Pigs can Transmit the Disease following an Inoculation of Virus

Dorset, McBryde and Niles (1908) reported that when susceptible pigs were placed in contact with pigs immunised by the serum-virus method, they did not contract the disease unless the inoculated pigs showed severe reactions. Uhlenhuth, Meissner and Geiger (1933) found that pigs treated by the serum-virus method might excrete virus for a time in the urine, but that they did not become permanent "carriers."

The following experiment was carried out to determine whether pigs treated with vaccine, and later inoculated with virus, could transmit infection to susceptible in-contact pigs. Five pigs were given varying doses of vaccine and inoculated twenty-two days later with virus. The day after the inoculation of virus each pig was put in a clean sty with a susceptible pig, and kept in-contact for forty days. (See Table.)

Number of pig	Dose of vaccine c.c.	Dose of virus	Result of contact	Inoculation of susceptible pig on fortieth day with virus
Vaccinated 1219	180	1 c.c.	—	—
In-contact 1184	—	—	Remained normal	Died 9th day
Vaccinated 1223	20	1 c.c.	—	—
In-contact 1249	—	—	Remained normal	Died 14th day
Vaccinated 1220	20	1 c.c.	—	—
In-contact 1250	—	—	Swine fever	—
Vaccinated 1166	10	1 c.c.	—	—
In-contact 1248	—	—	Remained normal	Died 8th day
Vaccinated 1167	5	1 c.c.	—	—
In-contact 1255	—	—	Remained normal	Died 5th day
Virus control 1312	—	1 c.c.	—	Sick - killed for virus on 7th day

The vaccinated pigs remained normal after the inoculation of virus.

Pig 1250, susceptible in-contact pig, developed clinical symptoms of swine fever and was killed *in extremis* on the eighth day of illness. Autopsy showed enlargement and inflammation of the body lymph nodes, numerous petechiæ throughout the thoracic and abdominal cavities, a deep-seated, built-up ulcer in the cæcum and œdema of the cæcal mucous membrane.

Pig 1311, inoculated with a suspension of spleen from pig 1250, died of typical swine fever on the fifteenth day. It was evident therefore that vaccinated pig 1220, although remaining apparently normal after the inoculation of virus, transmitted infection to an in-contact pig. The remaining four vaccinated pigs did not transmit infection, following the inoculation of virus, to susceptible in-contact pigs.

Estimation of Protective Dose

To estimate an average protective dose of vaccine, different brews have been titrated on pigs (50-70 lb.) in doses of 10, 5, 3, 2 and 1 c.c., and tested twenty-one days later against the inoculation of virus. Additional information on this point has been obtained from the routine potency test made on every brew of vaccine

prepared; this test is made on pigs in doses of 5 c.c. and 3 c.c. only. With nearly all brews the protective dose has been between 3 c.c. and 1 c.c. One brew tested on two pigs in doses of 0.5 c.c. and 0.25 c.c., respectively, protected against a certain killing dose of virus. An occasional brew has failed to protect in doses smaller than 5 c.. This method of testing obviously gives only a rough estimate of potency, yet repeated tests of the same brew of vaccine have shown that it gives reasonably uniform results.

It is suggested that until more experience is gained from the use of the vaccine under the varying conditions that obtain in the field, the original recommendation on dosage by the Bureau of Animal Industry, Washington, should be followed, that is, 5 c.c. for pigs up to 70 lb. weight, and 10 c.c. for pigs over that weight. Adult stock should, in our opinion, be given a dose of 10 c.c.; with some batches of vaccine a smaller dose would be sufficient, but the potencies of different batches vary, and as there is no practicable method available at present for the accurate estimation of the virus content, on which the protective power presumably depends, it is advisable, especially with valuable stock, to err on the side of safety.

Duration of Immunity

The duration of immunity conferred by the vaccine does not yet appear to have been accurately estimated. McBryde and Cole (1936) showed that it conferred an immunity of at least six months' duration. Cole and McBryde (1941) tested the immunity at intervals of two to twelve months after vaccination. It was shown that of 214 pigs tested eight months after vaccination, 89 per cent. were adequately protected. No data were given on the tests of pigs vaccinated for a longer period than eight months.

In two experiments previously reported (Doyle, 1942), it was shown that the vaccine conferred a solid immunity for at least ten months. Two further tests have since been carried out on the duration of immunity.

EXPERIMENT I.

In this experiment immunity tests were carried out at intervals of six, nine and twelve months after vaccination. It was hoped to obtain in addition some information on:

(1) the relative values of vaccines prepared by incubation for six days and for fourteen days, respectively;

(2) the correlation between size of dose and duration of immunity.

Pigs 1730 *and* 1733 were inoculated with virus and bled out on the sixth day. Vaccine was prepared with crystal violet and disodium phosphate, and it was then divided into two parts; one part was incubated at 37 deg. C. for six days, and the other part at the same temperature for fourteen days. The tests were carried out on 24 pigs, divided into three groups; each group consisted of eight pigs, three treated with each vaccine and two untreated controls. The three groups were run together up to the time of testing. Two pigs inoculated with six-day vaccine had to be discarded on account of "cramp" of the legs (probably chronic *E. rhusiopathiæ* infection), induced presumably by the concrete floor of the sty. To overcome this trouble the remaining animals were allowed out during the day in a small paddock. The test virus (American strain) consisted of freeze-dried blood that had been stored *in vacuo* at —20 deg. C. All tests were made with this stock

virus in the same dose (1 c.c.) and strength. The term "remained normal" in the tables signifies that an animal appeared and fed normally, but was not temperatured. The immunity of the pigs at the six and nine months periods was tested against continuous contact infection: one of the control pigs was inoculated with virus and the other control allowed to contract infection by contact. The vaccinated pigs were thus subjected, over a considerable period, to continuous contact with two infected pigs. It has been suggested that the results obtained by this procedure may not represent the true degree of immunity conferred by the vaccine, as the pigs may have been receiving sub-infective doses of virus over a period, thus reinforcing a weak vaccinal immunity. This hypothesis appeared highly improbable, but in order to meet it, the immunity of the pigs in the twelve months group was tested by the inoculation of virus. It will be seen from the table that all pigs in the twelve months groups remained normal.

Tested interval after vaccination	Number of pig	Type of vaccine	Dose of vaccine	Immunity tested by	Result
	1818	6-day incubated	10 c.c.	contact infection	Remained normal
	1814	„	2 c.c.	„	„ „
6 months	1812	14-day incubated	10 c.c.	„	„ „
	1832	„	5 c.c.	„	„ „
	1881	„	2 c.c.	„	„ „
	1889	virus pig	—	—	Died 16th day
	1890	control	—	contact	Died 16th day
	1815	6-day incubated	10 c.c.	„	Remained normal
	1820	„	5 c.c.	„	„ „
	1811	„	2 c.c.	„	„ „
9 months	1819	14-day incubated	10 c.c.	„	„ „
	1830	„	5 c.c.	„	„ „
	1874	„	2 c.c.	„	Slight reaction
	1892	virus pig	—	—	Died 12th day
	1891	control	—	contact	Died 28th day
	1813	6-day incubated	10 c.c.	virus inoculation	Remained normal
	1816	„	2 c.c.	„	„ „
12 months	1822	14-day incubated	10 c.c.	„	„ „
	1817	„	5 c.c.	„	„ „
	1824	„	2 c.c.	„	„ „
	1887	virus control	—	„	Died 20th day

As all the pigs remained normal when tested with virus, the experiment gave no information on the relative values of six- and fourteen-day vaccines or on the relation of dose to duration of immunity. It showed, however, that vaccine in doses as small as 2 c.c. conferred a solid immunity on growing pigs for at least twelve months. The susceptibility of the control pigs which were kept with the vaccinated group throughout the period of isolation confirmed that swine fever had not been inadvertently introduced among the pigs.

EXPERIMENT II.

Ethylene Glycol-Crystal Violet Vaccine

The three vaccines used in duration of immunity tests up to this point were prepared with crystal violet and dibasic sodium phosphate. In this test the dibasic sodium phosphate was replaced by ethylene glycol.

The tests were carried out on thirty pigs, 40-50 lb. weight, divided into three groups of ten. Each group consisted of nine vaccinated pigs and one unvaccinated control; three pigs in each group were given 10 c.c. vaccine, three 5 c.c., and three 3 c.c. subcutaneously. The controls and vaccinated pigs were kept together in isolation on an outlying farm. At intervals of four, eight and twelve months after vaccination a group of pigs was moved to the Institute and tested for immunity by the subcutaneous inoculation of virus. Results shown in table.

Tested interval after vaccination	Number of Pig	Dose of vaccine	Result
Four months	3494	10 c.c.	Remained normal
	3499	10 „	„ „
	3504	10 „	„ „
	3498	5 „	„ „
	3513	5 „	„ „
	3505	5 „	„ „
	3511	3 „	„ „
	3502	3 „	„ „
	3514	3 „	„ „
	3510	Control	Died 11th day
Eight months	3527	10 c.c.	Remained normal
	3531	10 „	„ „
	3521	10 „	„ „
	3519	5 „	„ „
	3522	5 „	„ „
	3530	5 „	„ „
	3523	3 „	„ „
	3534	3 „	Slight reaction
	3529	3 „	Remained normal
	3525	Control	Died 15th day
Twelve months	3517	10 c.c.	Remained normal
	3518	10 „	„ „
	3533	10 „	„ „
	3515	5 „	„ „
	3528	5 „	„ „
	3526	5 „	„ „
	3516	3 „	„ „
	3520	3 „	Slight reaction
	3532	3 „	Remained normal
	3524	Control	Died 10th day

Ethylene glycol-crystal violet vaccine in doses of 10 c.c., 5 c.c. and 3 c.c., conferred a solid immunity for a period of twelve months against artificial infection with a virulent American strain of virus.

Immunity Tests after Vaccination

The strength of the immunity in pigs tested twelve months after vaccination has been so marked that a small experiment was carried out to determine whether any increase in the degree of immunity occurred after the twenty-first day, the time after vaccination at which the test virus is usually inoculated.

Twenty pigs of a uniform size and weight (about 70 lb.) were divided into four equal groups. The groups were vaccinated at intervals of thirty days, using the same brew of vaccine for each group. The pigs in each group were given varying doses of vaccine, i.e., 10 c.c., 5 c.c., 3 c.c., 2 c.c. and 1 c.c. Twenty-one

days after vaccination of the last group all the pigs with one control were inoculated with virus. The results are shown in table.

Pig number	Dose of vaccine	Virus after vaccine	Result
3774	10 c.c.	111 days	Remained normal
3772	5 „	„	„ „
3775	3 „	„	Moderate reaction—recovered
3773	2 „	„	Remained normal
3771	1 „	„	Died swine fever
3779	10 c.c.	81 days	Remained normal
3776	5 „	„	„ „
3777	3 „	„	„ „
3778	2 „	„	Died swine fever
3781	1 „	„	Died swine fever
3800	10 c.c.	51 days	Remained normal
3797	5 „	„	„ „
3802	3 „	„	„ „
3803	2 „	„	Died swine fever
3798	1 „	„	Died swine fever
3799	10 c.c.	21 days	Remained normal
3804	5 „	„	„ „
3801	3 „	„	„ „
3806	2 „	„	„ „
3796	1 „	„	Moderate reaction—recovered
3805	Virus control	—	Died 10th day

It would appear from these results that twenty-one days after vaccination is a suitable interval at which to carry out immunity tests and no evidence was obtained to suggest that the degree of immunity increased with the passing of time.

Comparative Test of Antigenicity of Nine Strains of Virus

In the course of work on the vaccine a number of strains of virus have been obtained through the courtesy of American laboratories. These strains were found to be immunologically identical and all were highly virulent, but their antigenicity, as judged by the protective value of vaccine prepared from them showed considerable variation. One strain (No. 8) was of particularly high antigenic value and for some years produced vaccine of exceptional potency, and then, probably as the result of freeze-drying, its antigenicity deteriorated but it still remained virulent. The clinical picture in pigs inoculated with this strain changed gradually from a rapidly fatal septicæmic infection to a slower type of disease in which nervous symptoms were prominent, but which always proved fatal. Among the remaining American strains were some that produced good vaccine whereas others produced vaccine of only moderate potency.

In order to examine further this aspect of vaccine production we have recently obtained eight new strains of virus from different American laboratories and have prepared vaccine from each strain. Strain No. 8 mentioned above was also included in this investigation. Each strain on being received was inoculated into a pig which was bled out on the sixth day and blood was stored in ampoules at —70 deg. C. At a later date this blood was inoculated into two pigs and these were used for the preparation of vaccine, using ethylene glycol in place of dibasic sodium phosphate. Nine lots of vaccine, corresponding to the different strains of virus, were prepared.

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Forty-five pigs of approximately the same age and weight (70-80 lb.) were used for the titration of these vaccines, each of which was inoculated subcutaneously into a group of five pigs in doses of 10 c.c., 5 c.c., 3 c.c., 2 c.c. and 1 c.c. One month after vaccination the degree of protection conferred by each vaccine was tested against the inoculation (1 c.c.) of a standard test virus. See table.

Virus strain	Pig number	Dose of vaccine	Virus one month after vaccination	Results
1	3917	10 c.c.	1 c.c.	Remained normal
	3915	5 „	„	Moderate reaction—recovered
	3920	3 „	„	Died 11th day
	3918	2 „	„	Severe reaction—recovered
	3934	1 „	„	Died 8th day
2	3919	10 „	„	Moderate reaction—recovered
	3923	5 „	„	Severe reaction—recovered
	3916	3 „	„	Remained normal
	3921	2 „	„	Died 19th day
	3922	1 „	„	Died 7th day
3	3959	10 „	„	Died 11th day
	3962	5 „	„	Died 8th day
	3961	3 „	„	Died 11th day
	3960	2 „	„	Shot *in extremis*
	3963	1 „	„	Shot *in extremis*
4	3957	10 „	„	Remained normal
	3958	5 „	„	„ „
	3955	3 „	„	„ „
	3949	2 „	„	„ „
	3953	1 „	„	„ „
5	3927	10 „	„	Remained normal
	3926	5 „	„	„ „
	3929	3 „	„	„ „
	3931	2 „	„	„ „
	3924	1 „	„	Severe reaction—recovered
6	3939	10 „	„	Remained normal
	3936	5 „	„	Died 9th day
	3940	3 „	„	Moderate reaction—recovered
	3938	2 „	„	„ „ „
	3933	1 „	„	„ „ „
7	3957	10 „	„	Remained normal
	3956	5 „	„	„ „
	3947	3 „	„	„ „
	3954	2 „	„	„ „
	3952	1 „	„	Died 9th day
8	3935	10 „	„	Moderate reaction—recovered
	3932	5 „	„	„ „ „
	3937	3 „	„	Died 8th day
	3930	2 „	„	Died 19th day
	3925	1 „	„	Severe reaction—recovered
9	4038	10 „	„	Remained normal
	4033	5 „	„	„ „
	4118	3 „	„	„ „
	4121	2 „	„	„ „
	4116	1 „	„	„ „

It will be seen from the Table that there was a marked difference in the antigenic value of the different strains of virus. Strains 1, 2, 3, 6 and 8 were of low antigenic value and produced weak vaccines; and, as usually occurs with

weak vaccines, there was little correlation between size of dose and degree of protection. Strains 4 and 9 proved to be highly antigenic, and strains 5 and 7, while of good antigenicity, were rather less than 4 and 9. The results show clearly what might, perhaps, have been expected, that all virulent strains of swine fever virus are not of equal antigenic value and that virulence alone is not a safe criterion on which to select a strain for vaccine production.

As virus 4 induced high temperatures in pigs within three days of inoculation, gave rise to typical and extensive petechiæ in the predilection sites and produced vaccine of high antigenic value, this strain was provisionally selected for routine vaccine production. A final test was made to verify that it was immunologically identical with the other seven strains used; strain 8 was not included in this test.

Eight pigs of approximately the same size and weight (80-85 lb.) were given 10 c.c. of vaccine prepared from virus strain No. 4. Thirty days later each pig was inoculated (1 c.c.) with one of the American strains of virus. One vaccinated pig (No. 4007), given virus strain 2, showed inappetence for a few days and then recovered. The other seven vaccinated pigs remained normal. In view of the special conditions obtaining at present and the consequent need for economy in experimental animals, controls were not included in this test to confirm the virulence of the different strains of virus used, but recent inoculations had shown them to be of high virulence.

Conclusion

(1) The vaccine confers protection for at least twelve months. No evidence was found of any increase in the degree of protection between the 21st and 111th day after vaccination.

(2) The vaccine protects unweaned pigs the progeny of crystal violet vaccinated sows.

(3) Swine fever immune serum can be given either five days before or five days after vaccination without inhibiting the antigenic action of the vaccine.

(4) Attempts to reactivate the virus contained in the vaccine failed.

(5) Strains of virus suitable for vaccine production cannot be selected on the basis of virulence alone, as there is considerable variation in antigenicity among virulent strains.

(6) There was no appreciable loss in potency of vaccine stored for 248 days at room temperature (55° F.) or for 3½ years in the cold room (34° F.).

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ABSTRACT

THE ROLE OF MICROFLORA OF THE ALIMENTARY TRACT OF HERBIVORA WITH SPECIAL REFERENCE TO RUMINANTS

DIGESTION and metabolism in the ruminant have long been problems of special interest in nutrition. Under the above title, in *Nutrition Abstracts and Reviews*, Vol. 17, No. 1, July, 1947, are to be found an introduction and four special reviews dealing with these phenomena.

In the first review, F. Baker and S. T. Harris discuss the decomposition of structural cellulose by microbial agents in the rumen and cæcum. Firstly, they consider direct microscopic methods in the detection of micro-organisms concerned in the breakdown of cellulose, many of the methods being of very recent application. Next there is a review of the nature of the different micro-organisms involved in the process, which is followed by a survey of the microscopic features of cellulose breakdown, including a consideration of the protective effects of encrusting substances. A short but interesting section is devoted to the interaction of mechanical factors, e.g., chewing, and microbiological action, and the writers conclude with examinations of the microbial digestion of starch, of the nature of the products of bacterial synthesis, of the fate of the organisms, and of the interrelationships of the species involved.

With equal facility A. T. Phillipson writes on the formation of fatty acids in the rumen, showing how recent work has proved the principal volatile fatty acid to be acetic acid. Evidence is then brought forward to suggest that other carbohydrates than cellulose and hexoses in grass are concerned in the process. After a short paragraph on the mechanism of absorption of the fatty acids, some time is devoted to their metabolism, especially with the place of acetic acid as a source of energy, of carbohydrate or of fat. In a concluding section, Phillipson indicates the use of the volatile fatty acids as sources of energy, and points out that the energy to be derived from volatile fatty acids could account for 46 to 120 per cent. of the fasting requirements of the Holstein cow and for a large proportion of the fasting requirements of the merino sheep.

In their review of nitrogen metabolism in the rumen, J. A. B. Smith and M. L. McNaught summarise the evidence in favour of the theory that protein synthesis in the rumen is most likely on diets rich in starch and poor in protein. Next follows a consideration of the nutritive value of rumen protein, together with estimates as to the probable amounts of such material synthesised under various conditions. Feeding experiments, which have not involved metabolic studies, are then surveyed. From a very interesting list of conclusions, the following may be quoted as being of direct interest to veterinarians:

"The economy of utilisation [of nitrogen] will be highest when the protein of the diet is sparingly soluble in rumen fluid and the non-protein nitrogen (N.P.N.) is present with starch in an amount that does not exceed the bacterial requirements for nitrogen.

"In computing rations, it is probably wise to continue to reckon the N.P.N.

of feeding stuffs as having only half the value of the same amount of protein nitrogen.

"The deliberate use of N.P.N. compounds in rations will be successful only when the available feeding stuffs are rich in starch and poor in protein, and when the protein is only sparingly soluble."

In the fourth of the reviews, S. K. Kon and J. W. G. Porter discuss principally the microbial synthesis of the water soluble vitamins. Of the fat soluble vitamins, vitamin K is the only one which may be produced in this way and be utilised by the host. The authors quote proofs of the bacterial syntheses of vitamin B_1, biotin, folic acid, nicotinic acid, pantothenic acid, vitamin B_6 and riboflavin: vitamin C is produced in the ruminant by other means than microbial synthesis. Practical points the authors stress are the vulnerability of the young calf in its non-ruminant stage with respect to biotin and riboflavin deficiencies, and the value of colostrum and milk as sources of vitamins for it during that period.

This group of reviews, each of which has abundant references, is one of the most stimulating that has yet appeared in a series which has always maintained a high standard. It will be of interest to a wide field of workers, including veterinary practitioners who are concerned with ruminants.

J.T.A.

REVIEWS

Beagle and Terrier: Their Training and Management at Home and in the Field. By Roger Free. London: Chapman & Hall, Ltd. Price 8s. 6d. net.

FIELD sports are surrounded by tradition, and many who have not had the good fortune to be introduced to them during their youth are often adamant at pursuing them later in life.

Mr. Free's book gives an excellent introduction, for both young and old, into the ways of men with beagle and working terriers. Every aspect of kennel life and field work is discussed in a most sound and practical manner which retains the reader's interest throughout the book.

It can safely be said that anyone with no prior knowledge of beagles or working terriers could, by a careful study and application of the book, soon have a well-disciplined and healthy pack at his command with which to provide a wealth of sport.

The author is to be congratulated on the sections of his book concerned with feeding, rearing and health of his hounds as the opinions expressed are based on sound, practical and commonsense procedures for the control of disease and the maintaining of hounds in hard working conditions. S.H.

Fifteenth to Eighteenth Annual Reports of the Hannah Dairy Research Institute.

THIS report covers the four years ending 31st March, 1947, and reviews the research work of the Institute during that period. Most of this work has already been published elsewhere or is in process of publication, and the present report summarises, in effect, some fifty original papers and half-a-dozen special reports. A large part of the activities of the Institute have been concerned with

various aspects of Animal Nutrition, among which may be noted studies of methods for achieving greater farm self-sufficiency in supplies of animal feeding-stuffs, especially the production of grass and other green fodder crops and grass conservation by artificial drying; methods of storing feeding-stuffs to prevent their deterioration through insect infestation or mould growth; investigation of possible synthetic protein substitutes for dairy cows; and observations on the feeding of iodinated protein for raising the milk yield.

Another aspect of the Institute's work has been in connection with the housing of dairy cattle, and in the period under review studies have been made of the air temperature, humidity, air movement, rate of air charge and cooling capacities of two types of byre in the West of Scotland. The solution of these problems in byre ventilation has been handicapped by present ignorance regarding the subject of animal acclimatisation, and the Institute has, therefore, initiated an investigation into the questions of heat tolerance and the mechanism of temperature control in cattle.

Studies connected with animal health have been continued, viz., the detection, incidence and treatment of bovine mastitis, the effect of the season and of the vitamin stores of the dam on the incidence of calf mortality, and the value of sulphaguanidine in the treatment of white scours.

The remainder of the Report deals with technical research on milk and milk products. A list of publications and special reports issued by the Institute is given, together with a list of reprints of papers by members of the staff published since March 31, 1943.

NOTES AND NEWS

EPIZOOTICS AMONG HORSES IN POLAND*

THE Polish Ministry of Agriculture considers that at present Poland is still short of at least 2 million horses. Before the war the total amount of horses in Poland was 4 million, whereas only one million and a half were to be found on Polish land at the end of the war.

For centuries Poland concentrated on the breeding of Arab horses, and the first stud-farm of this breed was established as far back as in the 16th century by King Zygmunt August in Knyszyn. In pre-war days the main stud-farm of Arab horses was located in Janow Podlaski and produced a very valuable export material, bringing the Polish Treasury considerable amounts of foreign valuta. During the last stage of the war, the bulk of these horses of high breeding were evacuated by the Germans to the Western part of their country, where many perished. Some have survived and found their way to the United States, including the famous stallion "Letnik," considered to be the pride of Europe's breeding. The Polish Government is now negotiating with the United States for the return of these horses. Out of the hundreds of horses of high breeding possessed by Poland before 1939, only 32 could be found after the war to form the nucleus of future horse breeding in Nowy Dwor, near Zywiec. In addition to this stud-farm, another breeding centre has been established in Posadow, near Poznan.

* From the Polish Embassy, London.

In the meantime the Government has been fully engaged in importing horses from all available sources to fill up the gap caused by war devastations inasmuch as the surviving horses represented a very poor stock, underfed for long years and including many unfertile mares.

On the basis of reparations, the Government obtained 1,500 horses from Germany. Unrra brought 100,000 horses, 45,000 were purchased from Denmark and 5,000 from Sweden. A total of 10,350 head were purchased from Holland, France, Norway and Finland.

This mass import of livestock, unprecedented in history, combined with the huge transfers of domestic animals from the Baloans and from the East via Polish lands to Germany carried on by the retreating German armies during the last two years of the war, brought about the outbreak of various epizootics among horses, including troubles previously little known in Poland, such as, for instance, contagious anæmia and the dourine.

To cope with this sad aftermath of the war, the Polish Government had only 1,300 veterinary surgeons at their disposal, whereas at least 3,000 were necessary. Despite this acute shortage of qualified workers, the Polish Veterinary Service has succeeded in subduing the epizootics, which are now on a very pronounced decline. The horses most severely affected had to be destroyed. A number of stallions were castrated and artificial insemination had to be practised. The inoculation with the "ultravirus" of Kress gave excellent results in combating the contagious abortion of mares. The Research Veterinary Institute of Pulawy resumed its work and soon afterwards similar institutions were opened in Bydgoszcz, Gorzow and Dralewe.

These research institutes concentrate on working out preventive methods which would permit of the recognition of glanders and of dourine in their earliest stage. Therapeutic methods are also being studied.

As a matter of fact, during the first months following the end of the war the epizootics of glanders reached such a dangerous stage that even human casualties took place. The energetic measures taken against this disease have also borne fruit, so that at present the main obstacles to a further and successful development of horse breeding are practically removed.

RESEARCH ON PROTEIN-PROVIDING CROPS*

FINDING enough protein-rich foods continues to be one of the major problems facing stock farmers, whether they are producing meat or milk or are rearing. And from many points of view, the bean crop is the most attractive source of protein to be grown in this country.

Cultivation of the crop is very like that needed for cereals. No special equipment is necessary for growing or harvesting and, after a legume, the land is left in good condition for the succeeding crop. Most important of all, perhaps, beans mixed with equal parts of oats make up an excellent balanced ration for milk or meat production—4 lb. of the mixture replacing as much bought concentrate as is needed to produce a gallon of milk or 1 lb. of meat. But in spite of all this,

* Ministry of Agriculture News Service, 429, December 9, 1947.

beans are, perhaps, the most disappointing crop grown at the present time. In fact, many farmers have given up trying to produce protein from this source.

Some people think that the crop has deteriorated in the last fifty years, though it is difficult to find evidence for this. But it is encouraging to know that research workers are tackling the problem. At the Cambridge Plant Breeding Institute, different stocks of beans are being collected from all parts of this country and from abroad, in an effort to secure improved standard varieties. This is the first step towards breeding new and improved varieties. At the same time, cultivation trials will be required to find out the best means of cultivating and manuring the crop. So far very little experimental work has been done on this crop, for between the two wars imported protein was cheap and plentiful, so there was little inducement to farmers in this country to grow their own. Then there are the questions of pest and disease. Chocolate Spot is a menace still to be overcome, and in some seasons Black Fly can take a heavy toll of crops. Whether it will be possible to breed resistant strains, as with potatoes, remains to be seen.

On many soils where beans do not succeed, peas are a valuable alternative. Here, again, plant breeders are making good progress in providing the farmer with new strains. Peas are a risky crop to harvest—bad weather after cutting may result in a complete loss. The main effort in plant breeding is to secure earlier ripening and stiffer strawed varieties.

One very promising hybrid has been on trial for the first time this last year. If the early promise is repeated over the three-year trials required before a new variety can be recommended to farmers with confidence, the result will be a considerable expansion of the area under this crop. The maple pea—the principal variety used so far—is too late and too weak strawed. A further advantage of the earlier ripening characteristics now aimed at will be to provide a better opportunity for a bastard fallow before the next crop need be sown. Peas, more than other crops, tend to encourage rubbish.

Publishers' Notices

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Letters for the Journal, literary contributions, reports, notices, books for review, exchanges, new instruments or materials, and all matter for publication (except advertisements) should be addressed to the Editor.

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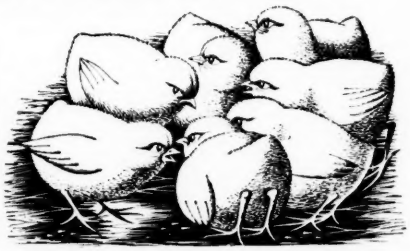

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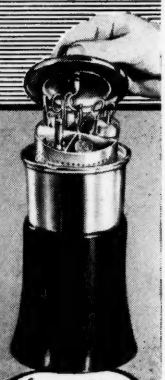

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